

NASA TECHNICAL MEMORANDUM

NASA TM X-73349

(NASA-TM-X-73349-Vol-3) SPACELAB EXPERIMENT
COMPUTER STUDY. VOLUME 3: SPACELAB COST
DATA (NASA) 90 p HC A05/MF A01. CSCL 22B

N77-13099

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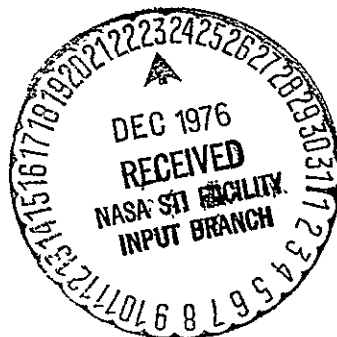
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SPACELAB EXPERIMENT COMPUTER STUDY Vol III: Spacelab Cost Data

By James L. Lewis, Bobby C. Hodges, and James O. Christy
Data Systems Laboratory

April 1976

NASA



*George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama*

1. REPORT NO. NASA TM X-73349	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.	
4. TITLE AND SUBTITLE SPACELAB EXPERIMENT COMPUTER STUDY Volume III: Spacelab Cost Data		5. REPORT DATE April 1976	
		6. PERFORMING ORGANIZATION CODE	
7. AUTHOR(S) James L. Lewis, Bobby C. Hodges, and James O. Christy		8. PERFORMING ORGANIZATION REPORT #	
9. PERFORMING ORGANIZATION NAME AND ADDRESS George C. Marshall Space Flight Center Marshall Space Flight Center, Alabama 35812		10. WORK UNIT NO.	
		11. CONTRACT OR GRANT NO.	
		13. TYPE OF REPORT & PERIOD COVERED Technical Memorandum	
12. SPONSORING AGENCY NAME AND ADDRESS National Aeronautics and Space Administration Washington, D. C. 20546		14. SPONSORING AGENCY CODE	
15. SUPPLEMENTARY NOTES This is Volume III of five volumes.			
16. ABSTRACT <p>The purpose of this study was to provide a quantitative cost for various Spacelab flight hardware configurations, along with varied software development options. The three major conclusions reached as a result of this study are as follows:</p> <ol style="list-style-type: none"> 1. Spacelab program cost for software development and maintenance is independent of experimental hardware and software options. 2. Distributed standard computer concept simplifies software integration without a significant increase in cost. 3. Decision on flight computer hardware configuration should not be made until payload selection for a given mission and a detailed analysis of the mission requirements are completed. <p>This report is published in five volumes: Volume I contains the Executive Summary (Presentation); Volume II, Study Elements and Approach; Volume III, Spacelab Cost Data; Volume IV, Spacelab User Cost Data (Central Experiment Computer); and Volume V, Spacelab User Cost Data (Distributed Computer).</p> <p>This is Volume III: Spacelab Cost Data, which provides the detailed costing methods and cost data.</p>			
17. KEY WORDS		18. DISTRIBUTION STATEMENT Unclassified-Unlimited	
19. SECURITY CLASSIF. (of this report) Unclassified	20. SECURITY CLASSIF. (of this page) Unclassified	21. NO. OF PAGES 89	22. PRICE NTIS

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1.1 Costing Method

1.2 Cost Data

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Facility Local. (Not Priced -
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SPACELAB EXPERIMENT COMPUTER STUDY

VOLUME III SPACELAB COST DATA

SECTION 1 Costing Method

1.1 CDMS Hardware Modifications

3 - 16K Modules

Estimated cost per 16K module = \$30K

(A) = 3 (\$30K) = \$90K - One time cost FY79

Note: Provision for cost of memory for back-up computer
was not costed.

1.2 Subsystem Computer Software Development and Acceptance

Cost Factors

- o Acceptance Test Development
- o Acceptance Review
- o Installation at NASA

(1) Acceptance Test Development

(A) ((Level of Effort) (Cost/Man Yr.) + Travel/Yr.) 1 Yr.
 until Acceptance

Level of Effort = Engineering Estimate Manpower = 1 Man

Cost/Man Year = \$50K

Travel = Number of Trips (Cost of Ticket + (Number Days
 X Cost/Day)

Number of Trips = Engineering Estimate = 2

Cost of Ticket = \$800

Cost/Day = \$40 Per Diem + \$20 for car = \$60

Number of Days = Engineering Estimate = 14

(A) = 1 X \$50K + 2 (\$800 + (14 X 60)) Per year
= (\$56,560) Per year

(A) Total = \$56,560 per year for 3 years and 5 months
Starting in FY77

(2) Acceptance Review

(A) (Level of Effort (Number of Modules)) per year
until review is complete

Level of Effort = Engineering Estimate = .15 man weeks

1 man week = (\$962) (.15) = \$144/man week

Number of Modules = ESA Estimate = 49

(A) = (\$144 man weeks) (49 modules)) per year
= (\$7,056) per year

(A) Total = \$7,056 per acceptance
_____ Starting in FY79

2 Acceptance Reviews in FY79

1 Acceptance Review in FY80

(3) Installation at NASA

(A) (Level of Effort (Number of Modules)) per year
until installation is complete

1 man week = (\$962) (.5) = \$481/man week

Number of Modules = ESA Estimate = 49

Level of Effort = Engineering Estimate = .5 Man Weeks

(A) = (\$481/Man Wk(s) (49 Modules)) Per Yr.
= (\$23,570) Per Yr.

(A) Total = \$23,570 per installation
Starting in FY79

2 Installations in FY79

1 Installation in FY80

ESA ESTIMATES OF DELIVERED SOFTWARE

SUBSYSTEM COMPUTER

	<u>Size</u>	<u>HOL</u>	<u>Modules</u>
1. Exp. CDMS C/O	.7K	140	2
2. S/S CDMS C/O	.7K	140	2
3. EPDS C/O	.3K	60	1
4. ECS C/O	.4K	80	1
5. Inflight Power Monitor	.3K	60	1
6. Inflight Monitor	.7K	140	2
7. SCOS —	<u>20.0K</u>	<u>4,000</u>	<u>40</u>
Total	23.1K	4,620	49

1.3 Subsystem Computer Software Maintenance

Cost Factors

(1) Maintenance

(A) = ((Number of Assembly Instructions) (Change Rate)
(Cost Per Assembly Instruction)) Per Flight per year

Number of Assembly Instructions = ESA Estimate = 0

Change Rate = Engineering Estimate = 5 percent per flight

Cost per Assembly Instruction = Engineering Estimate
=\$100 per Instruction

Per Flight = Flights per year = Mission Model

(A) = ((0) (5 %) (\$100)) Per Flight/Yr.
= (\$ 0) Per Flight/Yr.

(A) Total = (\$ 0) Per Flight for 11 years
Starting in FY80

(1) Maintenance

(B) = ((Number HOL Statements) (Change Rate) (Cost
per HOL Statement)) Per Flight Year

Number HOL Statements = ESA Estimate = 4,620

Change Rate = Engineering Estimate = 5% Per Flight

Cost Per HOL Statement = Engineering Estimate = \$60
Per Statement

Per Flight = Flights Per Year = Mission Model

(A) = ((4,620) (5%) (\$60)) Per Flight/Year) For 3 Years
____ = (\$13,860) Per Flight/Year For 3 Years

(A) Total = (\$13,860) Per Flight For 3 Years
Starting in FY80

FY83 thru 91

(\$13,860) Per Delivery/Year

2 Deliveries/Year

(\$27,720) Per Year Starting FY83

SUBSYSTEM COMPUTER

1.4 Subsystem Computer Software Configuration Management,
Release, and Distribution

- o Configuration Management
- o Set Build and Verification (Includes Documentation and Distribution)

$$\text{Average Cost Per Module} = \frac{(\text{Level of Effort}) (\text{Cost Per Man Year})}{\text{Total Number of Delivered Modules}}$$

ACM = (3 Man yrs.) (\$50K) ÷ 636 Modules = \$235 Per Module

(A) = ((49) (\$235)) Per Yr. Per Yr.

= (\$11,515) Per Yr. Per Yr.

(A) Total = (\$11,515) Per Yr. For 12 Yrs.
Starting FY79

(2) Set Build and Verification (Includes Documentation and Distribution)

(A) ((Level of Effort) (Number of Sets Per Flight)
(Number Flights Per Yr.)) Per Yr.

Level of Effort = Engineering Estimate = Number

Man Weeks Per Set = 1 Man Week(s)

Number of Sets Per Flight = Engineering Estimate = 2

Number of Flights Per Yr. = Mission Model

(A) = ((\$962) (2) (Number of Flights Per Yr.)) Per Yr.
= (\$1,924) Per Flight (Number Flights) Per Yr.

(A) Total = (\$1,924) Per Flight for 11 Yrs.
Starting FY80

ESA ESTIMATES OF DELIVERED SOFTWARE

SUBSYSTEM COMPUTER

	<u>Size</u>	<u>HOL</u>	<u>Modules</u>
1. Exp. CDMS C/O	.7K	140	2
2. S/S CDMS C/O	.7K	140	2
3. EPDS C/O	.3K	60	1
4. ECS C/O	.4K	80	1
5. Inflight Power Monitor	.3K	60	1
6. Inflight Monitor	.7K	140	2
7. SCOS	<u>20.0K</u>	<u>4,000</u>	<u>40</u>
Total	23.1K	4,620	49

1.5 Experiment Computer Software Development and Acceptance

Cost Factors

- o Acceptance Test Development
- o Acceptance Review
- o Installation at NASA

(1) Acceptance Test Development

(A) ((Level of Effort) (Cost/Man Yr.) + Travel/Yr.) / Yr.
until acceptance

Level of Effort = Engineering Estimate Manpower = 1 Man

Cost/Man Year = \$50K

Travel = Number of Trips (Cost of Ticket + (Number
Days X Cost/Day))

Number of Trips = Engineering Estimate = 4

Cost of Ticket = \$800

Cost/Day = \$40 Per Diem + \$20 for Car = \$60

Number of Days = Engineering Estimate = 14

(A) = 1 X \$50K + 4 (\$800 + (14X 60)) Per Yr. Per Yr.
= (\$56, 560) Per Yr. Per Yr.

(A) Total = \$56,560 Per Yr. for 3 Yrs. 0 Months
Starting in FY77

(2) Acceptance Review

(A) (Level of Effort (Number of Modules)) Per Yr.
Until Review Complete

Level of Effort = Engineering Estimate = .15 Man Weeks

1 Man Week = (\$962) (.15) = \$144/Man Week

Number of Modules = ESA Estimate = 42

(A) = (\$144 Man Week(s) (42 Modules)) Per Year
= (\$6,048) Per Year

(A) Total = \$6,048 Per Acceptance
Starting in FY78

1 Acceptance in FY78

1 Acceptance in FY79

1 Acceptance in FY80

(3) Installation at NASA

(A) (Level of Effort (Number of Modules)) Per Year
Until Installation Complete

1 Man Week = (\$962) (.5) = \$481/Man Week

Number of Modules = ESA Estimate = 42

Level of Effort = Engineering Estimate = .5 Man Weeks

(A) = (\$481/Man Week(s) (42 Modules)) Per Year
= (\$20,200) Per Year

(A) Total = \$20,200 Per Installation
Starting in FY78

1 Installation in FY78

1 Installation in FY79

1 Installation in FY80

(4) Graphics Software Package

Engineering Estimate of Development
1.2 Man Years

(1.2) X \$50,000 = \$60,000

ESA ESTIMATES OF DELIVERED SOFTWARE

EXPERIMENT COMPUTER

1.	Inflight Monitor	.7K	140	2
2.	ECOS	<u>20.0K</u>	<u>4,000</u>	<u>40</u>
	Total	20.7K	4,140	42

1.6 Experiment Computer Software Maintenance

Cost Factors

o Maintenance

(1) Maintenance

(A) = ((Number of Assembly Instructions) (Change Rate)
(Cost Per Assembly Instruction)) Per Flight
Per Year

Number of Assembly Instructions = ESA Estimate = 0

Change Rate = Engineering Estimate = 5% Per Flight

Cost Per Assembly Instruction = Engineering Estimate =
\$100 Per Instruction

Per Flight = Flights Per Year = Mission Model

(A) = ((0) (5%) (\$100)) Per Flight/Year
= (\$ 0) Per Flight Year

(A) = Total = (\$ 0) Per Flight for 11 Years
Starting in FY80

(1) Maintenance

(B) = ((Number HOL Statements) (Change Rate) (Cost
Per HOL Statement)) Per Flight Per Year

Number of HOL Statements = ESA Estimate = 4,140

Change Rate = Engineering Estimate = 5% Per Flight

Cost Per HOL Statement = Engineering Estimate = \$60
Per Statement

Per Flight = Flights Per Year = Mission Model

(A) = ((4,140) (5%) (\$60)) Per Flight/Year for New Flights
= (\$12,420) Per Flight/Year for (#38 new flights)

(A) Total = (\$12,420) Per (#38 new flights)
Starting in FY80

(B) ((4,140) (1%) (\$60)) Per (#39 Re-fly)/Yr.
(\$2,484) Per (#39 Re-fly)/Yr.

Total = (A) + (B) Per Year

1.7 Experiment Computer Software Configuration Management,
Release, and Distribution

Cost Factors

- o Configuration Management
- o Set Build and Set Verification (Includes Documentation
and Distribution)

(1) Configuration Management

(A) ((Number of Modules) (Average Cost Per Module))
Per Yr. Per Yr.

Number of Modules = ESA Estimate = 42

Average Cost Per Module = (Level of Effort) (Cost Per
Man Year) Total Number of Delivered Modules

$$\text{ACM} = (3 \text{ Man Yrs.}) (\$50\text{K}) \div 636 \text{ Modules} \\ = \$235 \text{ Per Module}$$

$$(A) = ((42) (\$235)) \text{ Per Yr. Per Yr.}$$

$$= (\$9,870) \text{ Per Yr. Per Yr.}$$

$$(A) \text{ Total} = (\$9,870) \text{ Per Yr. for 12 Yrs.} \\ \text{Starting FY78}$$

*(2) Set Build and Verification (Includes Documentation and
Distribution)

$$(A) ((\text{Level of Effort}) (\text{Number of Sets Per Flight}) (\text{Number} \\ \text{Flights Per Year})) \text{ Per Year}$$

$$\text{Level of Effort} = \text{Engineering Estimate} = \text{Number Man Weeks} \\ \text{Per Set} = .5 \text{ Man Week(s)}$$

$$\text{Number of Sets Per Flight} = \text{Engineering Estimate} = 1$$

$$\text{Number of Flights Per Year} = \text{Mission Model}$$

$$(A) = ((\$481) (1) (\text{Number of Flights Per Year})) \text{ Per Year} \\ = (\$481) \text{ Per Flight (Number Flights) Per Year}$$

$$(A) \text{ Total} = (\$481) \text{ Per Flight for 11 Years} \\ \text{Starting FY80}$$

* Includes Verification of Loading Characteristics on Central Computer
Imposed by DEP in Distributed Option

ESA ESTIMATES OF DELIVERED SOFTWARE

EXPERIMENT COMPUTER

	<u>SIZE</u>	<u>HOL</u>	<u>Modules</u>
1. Inflight Monitor	.7K	140	2
2. ECOS	20.0K	4,000	40
Total	20.7K	4,140	42

2.1 EGSE Hardware Modifications

(None Identified for This Option)

2.2 Ground Checkout Software Development and Acceptance

Cost Factors

- o Acceptance Test Development
- o Acceptance Review
- o Installation at NASA

(1) Acceptance Test Development

$$(A) \quad ((\text{Level of Effort}) (\text{Cost/Man Yr.}) + \text{Travel/Yr.}) / \text{Yr.} \\ \text{Until Acceptance}$$

Level of Effort = Engineering Estimate Manpower = 1 Man

Cost/Man Year = \$50K

Travel = Number of Trips (Cost of Ticket + (Number Days
X Cost/Day))

Number of Trips = Engineering Estimate = 4

Cost of Ticket = \$800

Cost/Day = \$40 Per Diem + \$20 For Car = \$60

Number of Days = Engineering Estimate = 14

$$(A) = 1 \times \$50K + 4(\$800 + (14 \times 60)) \text{ Per Year Per Year} \\ = (\$56,560) \text{ Per Year Per Year}$$

(A) Total = \$56,560 Per Year for 3 Years 0 Months
Starting in FY77

(2) Acceptance Review

$$(A) \quad (\text{Level of Effort (Number of Modules)}) \text{ Per Year} \\ \text{Until Review is Complete}$$

Level of Effort = Engineering Estimate = .15 Man Weeks

1 Man Week = (\$962) (.15) = \$144/Man Week

Number of Modules = ESA Estimate = 291

(A) = (\$144/Man Week(s) (291 Modules)) Per Year
= (\$41,904) Per Year

(A) Total = \$41,904 Per Acceptance
Starting in FY78

1 Acceptance in FY78

1 Acceptance in FY79

1 Acceptance in FY80

(3) Installation at NASA

(A) (Level of Effort (Number of Modules)) Per Yr.
Until Installation Complete

1 Man Week = (\$962) (.1) = \$96.20/Man Week

Number of Modules = ESA Estimates = 291

Level of Effort = Engineering Estimate = .1 Man Week

(A) = (\$96.20/Man Week(s) (291 Modules)) Per Year
= (\$27,995) Per Year

(A) Total = \$27,995 Per Installation
Starting in FY78

1 Installation in FY78

1 Installation in FY79

1 Installation in FY80

ESA ESTIMATE OF DELIVERED SOFTWARE

EGSE GROUND CHECKOUT

	<u>Size</u>	<u>HOL</u>	<u>Modules</u>
1. GCOS	21.8K	4,000	40
2. Self Test	30.0K	6,000	60
3. Data Reduction	5.0K	1,000	10
4. PCM A/D	1.0K	200	2
5. ESI/CDMS	3.0K	600	6
6. ESI/EPDS	3.0K	600	6
7. ESI/ECS	1.5K	300	3
8. ESI/Instrumentation	3.5K	700	7
9. Gnd. C/O CDMS	10.5K	2,100	21
10. Gnd. C/O EPDS	12.0K	2,400	24
11. Gnd. C/O ECS	4.0K	800	8
12. Gnd. C/O Pwr. On/Off	10.0K	2,000	20
13. Gnd. C/O Inst. Cal.	12.0K	2,400	24
14. Gnd. C/O Exp. Interface	8.8K	1,700	17
15. Gnd. C/O Integrated Test	20.0K	4,000	40
16. Gnd. C/O Monitor	<u>1.7K</u>	<u>300</u>	<u>3</u>
Total	145.5K	29,100	291

2.3 Ground Checkout Software Maintenance

Cost Factors

- o Maintenance

(1) Maintenance

(A) = ((Number of Assembly Instructions) (Change Rate)
(Cost Per Assembly Instruction)) Per Flight Per
Year

Number of Assembly Instructions = ESA Estimate = 0

Change Rate = Engineering Estimate = 5% Per Flight

Cost Per Assembly Instruction = Engineering Estimate
= \$100 Per Instruction

Per Flight = Flights Per Year = Mission Model

(A) = ((0) (5%) (\$100)) Per Flight/Year
= (\$ 0) Per Flight/Year

(A) Total = (\$ 0) Per Flight For 11 Years
Starting in FY80

(1) Maintenance

(B) = ((Number HOL Statements) (Change Rate) (Cost
Per HOL Statement)) Per Flight Per Year

Number of HOL Statements = ESA Estimate = 29,100

Change Rate = Engineering Estimate = 5% Per Flight

Cost Per HOL Statement = Engineering Estimate = \$30
Per Statement

Per Flight = Flights Per Yr. = Mission Model

(A) = ((29,100) (5%) (\$30)) Per Flight/Yr. (New #38)

= (\$43,650) Per Flight/Yr.

(A) Total = (\$43,650) Per Flight (New #38) for 11 Yrs.
Starting in FY80

(B) ((29,100) (1%) (\$30)) Per (Re-fly #39)/Yr.
(\$8,730) Per (Re-fly #39)/Yr.

Total = (A) + (B)

ESA ESTIMATE OF DELIVERED SOFTWARE

EGSE GROUND CHECKOUT

	<u>Size</u>	<u>HOL</u>	<u>Modules</u>
1. GCOS	21.8K	4,000	40
2. Self Test	30.0K	6,000	60
3. Data Reduction	5.0K	1,000	10
4. PCM A/D	1.0K	200	2
5. ESI/CDMS	3.0K	600	6
6. ESI/EPDS	3.0K	600	6
7. ESI/ECS	1.5K	300	3
8. ESI/Instrumentation	3.5K	700	7
9. Gnd. C/O CDMS	10.5K	2,100	21
10. Gnd. C/O EPDS	12.0K	2,400	24
11. Gnd. C/O ECS	4.0K	800	8
12. Gnd. C/O Pwr. On/Off	10.0K	2,000	20
13. Gnd. C/O Inst. Cal.	12.0K	2,400	24
14. Gnd. C/O Exp. Interface	8.8K	1,700	17
15. Gnd. C/O Integrated Test	20.0K	4,000	40
16. Gnd. C/O Monitor	<u>1.7K</u>	<u>300</u>	<u>3</u>
Total	145.5K	29,100	291

2.4 EGSE Ground Checkout Software Configuration Management, Release, and Distribution

Cost Factors

- o Configuration Management
- o Set Build

(1) Configuration Management

(A) ((Number of Modules) (Average Cost Per Module))
Per Yr. Per Yr.

Number of Modules = ESA Estimate = 291

Average Cost Per Module = (Level of Effort) (Cost Per
Man Year) \div Total Number of Delivered Modules

ACM = (3 Man Yrs.) (\$50K) \div 636 Modules
= \$235 Per Module

(A) = ((291) (\$235)) Per Yr. Per Yr.
= (\$68,385) Per Yr. Per Yr.

(A) Total = (\$68,385) Per Yr. for 12 Yrs.
Starting FY79

(2) Set Build and Verification (Includes Documentation and Distribution)

(A) ((Level of Effort) (Number of Sets Per Flight)
(Number of Flight Per Yr.)) Per Yr.

Level of Effort = Engineering Estimate = Number Man
Weeks Per Set = 1 Man Week(s)

Number of Sets Per Flight = Engineering Estimate = 2

Number of Flights Per Yr. = Mission Model

(A) = ((\$962) (2) (Number of Flights Per Yr.)) Per Yr.
= (\$1,924) Per Flight (Number Flights) Per Yr.

(A) Total = (\$1,924) Per Flight for 11 Yrs.
Starting FY80

ESA ESTIMATE OF DELIVERED SOFTWARE

EGSE GROUND CHECKOUT

	<u>Size</u>	<u>HOL</u>	<u>Modules</u>
1. GCOS	21.8K	4,000	40
2. Self Test	30.0K	6,000	60
3. Data Reduction	5.0K	1,000	10
4. PCM A/D	1.0K	200	2
5. ESI/CDMS	3.0K	600	6
6. ESI/EPDS	3.0K	600	6
7. ESI/ECS	1.5K	300	3
8. ESI/Instrumentation	3.5K	700	7
9. Gnd. C/O CDMS	10.5K	2,100	21
10. Gnd. C/O EPDS	12.0K	2,400	24
11. Gnd. C/O ECS	4.0K	800	8
12. Gnd. C/O Pwr. On/Off	10.0K	2,000	20
13. Gnd. C/O Inst. Cal.	12.0K	2,400	24
14. Gnd. C/O Exp. Interface	8.8K	1,700	17
15. Gnd. C/O Integrated Test	20.0K	4,000	40
16. Gnd. C/O Monitor	<u>1.7K</u>	<u>300</u>	<u>3</u>
Total	145.5K	29,100	291

2.5 EGSE Computer Software Production Set Development and Acceptance

Cost Factors

- o Acceptance Test Development
- o Acceptance Review
- o Installation At NASA

(1) Acceptance Test Development

(A) $((\text{Level of Effort}) (\text{Cost/Man Yr.}) + \text{Travel/Yr.}) / \text{Yr.}$
until Acceptance

Level of Effort = Engineering Estimate Manpower = 1 Man

Cost/Man Year = \$50K

Travel = Number of Trips (Cost of Ticket + (Number of Days X Cost/Day))

Number of Trips = Engineering Estimate = 4

Cost of Ticket = \$800

Cost/Day = \$40 Per Diem + \$20 for Car = \$60

Number of Days = Engineering Estimate = 14

(A) $= 1 \times \$50K + 4(\$800 + (14 \times 60))$ Per Yr. Per Yr.
 $= (\$56,560)$ Per Yr. Per Yr.

(A) Total = \$56,560 Per Yr. for 2 Yrs. 0 Months
Starting in FY77

(2) Acceptance Review

(A) (Level of Effort (Number of Modules)) Per Yr. Until
Review Complete

Level of Effort = Engineering Estimate = .15 Man Weeks

1 Man Week = (\$962) (.15) = \$144/Man Week

Number of Modules = ESA Estimate = 64

(A) = (\$144/Man Week(s) (64 Modules)) Per Yr.
= (\$9,220) Per Yr.

(A) Total = \$9,220 Per Acceptance
Starting in FY78

1 Acceptance in FY78

(3) Installation at NASA

(A) (Level of Effort (Number of Modules Per Yr.
Until Installation Complete

1 Man Week = (\$962) (.1) = \$96.20/Man Week

Number of Modules = ESA Estimate = 64

Level of Effort = Engineering Estimate = .1 Man Weeks

(A) = (\$96.20/Man Week(s) (64 Modules)) Per Yr.
= (\$6,160) Per Yr.

(A) Total = \$6,160 Per Installation
Starting in FY78

1 Installation in FY78

TYPICAL REQUIREMENTS (REGION) NOT ESA ESTIMATE

*EGSE PRODUCTION SET

	<u>Size</u>	<u>HOL</u>	<u>Modules</u>
1. Macro Assembly	8.0K	1,600	16
2. Linkage Editor	4.0K	800	8
3. ANSI Fortran	16.0K	3,200	32
4. Utilities	<u>4.0K</u>	<u>800</u>	<u>8</u>
Total	32.0K	6,400	64

* GCOS Included in Ground Checkout

2.6 EGSE Computer Software Production Set Maintenance

Cost Factors

o Maintenance

(1) Maintenance

$$(A) = ((\text{Number of Assembly Instructions}) (\text{Change Rate}) \\ (\text{Cost Per Assembly Instruction})) \text{ Per Yr. Per Yr.}$$

Number of Assembly Instructions = ESA Estimate = 32K

Change Rate = Engineering Estimate = 1%

Cost Per Assembly Instruction = \$100 Per Instruction

$$(A) = ((32K) (1\%) (\$100)) \text{ Per Yr. Per Yr.} \\ = (\$32,000) \text{ Per Yr. Per Yr.}$$

$$(A) \text{ Total} = (\$32,000) \text{ Per Yr. for 12 Yrs.} \\ \text{Starting in FY79}$$

TYPICAL REQUIREMENTS (REGION) NOT ESA ESTIMATE

* EGSE PRODUCTION SET

	<u>Size</u>	<u>HOL</u>	<u>Modules</u>
1. Macro Assembly	8.0K	1,600	16
2. Linkage Editor	4.0K	800	8
3. ANSI Fortran	16.0K	3,200	32
4. Utilities	<u>4.0K</u>	<u>800</u>	<u>8</u>
Total	32.0K	6,400	64

* GCOS Included in Ground Checkout

2.7 EGSE Computer Software Production Set Configuration Management, Release, and Distribution

Cost Factors

(1) Configuration Management with Set Build and Verify Only Required on Error Changes

(A) ((Level of Effort) (Cost Per Man Yr.) (Number of Set Builds Per Yr.)) Per Yr.

Level of Effort = Engineering Estimate = .04 Man Yr.

Cost Per Man Yr. = \$50K

Number of Set Builds = Engineering Estimate = 4

(A) = ((.04) (\$50K) (4)) Per Yr. Per Yr.
= (\$8,000) Per Yr. Per Yr.

(A) Total = \$8,000 Per Yr. for 12 Yrs.
Starting in FY79

3.1 Facility Acquisition

Cost Factors

- o Host Computer
- o Computer Interface Device
- o Simulation Computer
- o CDMS
- o EGSE
- o Facility Integration and Testing
- o Consumable Stock
- o Facility Modifications
- o Engineering Design

(1) Host Computer

(A) (Basic 360/65) + (Maintenance) Per Yr. +
(Additional Equipment) + (Maintenance) Per Yr.

Basic 360/65 - Assume Existing Facility with no cost to
Spacelab

Maintenance = GSA Schedule = \$54,489/Yr.

Additional Equipment = \$589,716

Maintenance = \$12,957/Yr.

(1) (A) Total = \$589,716 + \$67,446/Yr.

(2) Computer Interface Device

(A) (Equipment) + (Maintenance) Per Yr.

ORIGINAL PAGE IS
OF POOR QUALITY

(Equipment) = M&S Study = \$186,200

(Maintenance) = 8% of (Purchase - Test) = \$12,896/Yr.

(2) (A) Total = \$186,200 + (\$12,896) Per Yr.

(3) Simulation Computer

(A) (Equipment PDP 11/70) + (Maintenance) Per Yr.

(Equipment) = M&S Study = \$137,200

(Maintenance) = 8% of Purchase/Yr. = \$10,976/Yr.

(3) (A) Total = \$137,200 + \$10,976/Yr.

(4) CDMS

(A) (CDMS) + (Maintenance) Per Yr.

(CDMS) = ESA Estimate = \$1,920,000

(Maintenance) = 8% of Purchase/Yr. = \$153,600/Yr.

(4) (A) Total = \$1,920,000 + \$153,600/Yr.

(5) EGSE

Not Required

(6) Facility Integration and Testing

(A) (Level of Effort) (Cost Per Man Yr.)

Level of Effort = Engineering Estimate = 6 People
for 2 Mo. = 1 Man Yr. (1) (\$50,000) = \$50,000

(6) = \$50,000

(7) Consumable Stock

(A) Consumable Stock = Engineering Estimate = \$105,173

(7) = \$105,173

(8) Facility Modifications

(A) Engineering Estimate = \$99,000

(8) = \$99,000

(9) Engineering Design

(A) Engineering Design = 2 People for 6 months =
1 Man Yr. = \$50,000

(9) = \$50,000

3.1 STIL - IBM 360/65 (Current)

No.	Equipment Item	Purchase	Maint. /Mo.
1.	2065-1 CPU	\$558,000	\$450.00
1.	1052 Adapter	10,400	9.00
1.	2365 Processor Storage (1 Megabyte)	393,000	418.00
1.	2860-3 Selector Channel	184,000	127.00
1.	2870-1 Multiplexor Channel	105,000	98.00
1.	2403 Tape Control Unit (9-Track, Dual Density)	71,610	143.25
1.	2403 Tape Control Unit (7-Track)	68,450	132.25
6.	3420-7 Tape Drive (22,800/66.00) (9-Track, Dual Density)	132,800	396.00
2.	3420-7 Tape Drive (30,410/117.00) (7-Track)	60,810	234.00
1.	2821-1 Control Unit	37,900	44.75
1.	3615 1100 LPM Line Printer Adapter	2,440	1.00
1.	2821-2 Control Unit	23,500	34.50
1.	3615 100 LPM Line Printer Adapter	2,400	1.00
2.	1403-N1 Printer (34,600/200.00) (2,960)	69,200	400.00
2.	1416-1 Interchg. Train Cartridge	5,920	
1.	2540-1 Card Read/Punch	33,500	126.00
2.	3830-1 Disk Controller (97,700/147.00)	195,400	294.00
16.	3330-1 Disk Drive (31,600/102.00)	<u>505,600</u>	<u>1,632.00</u>
		\$2,459,970	\$4,540.75/Mo.
			x 12 Mo. Yr.
			<u>\$54,489/Yr.</u>

3.1 Simulation Computer

PDP 11/35 FL	Includes Processor, Memory Management, Stack Limit Option, 32K Core Memory	\$20,495
KELLE	Extended Inst. Set	1,400
KELLF	Floating Point	1,500
MF11-UR	32K Core Memory (Parity)	8,700
DB11-A	Peripheral Mounting Panel	200
BM873YA	Bootstrap Loader	400
KL11-A	Asynchronous Line Interface to Drive Graphics Display	500
RK11DE	Moving Head Disk Drive and Controller	11,000
LS11A	Line Printer 132 Col, 64 Ch 60 LPM	5,615
TMA11-EA	9 Tr Magnetic Tape & Controller	10,745
TU10EE	2nd Tape Drive	7,505
CR11	300 CPM Card Reader	4,860
DR11-B	Parallel DMA I/F	1,400
4014, 2, 30, 31, 34	Graphics Display	9,000
MSP007	Graph Tablet I/F	1,200
MSP004	Refresh Memory	1,200
HW-1-11S	11 x 11 Tablet and Control	3,000
613	2nd Display	3,000
2MF11-UR	Additional 64K Memory	17,400
H960-DH	Mounting Rack	3,000
---	Upgrade to PDP 11/70	<u>25,000</u>
		\$137,200

3.1 Additional Cost for Equipment Beyond Basic 360/65

No.	Equipment Item	Purchase	Maint. /Mo.
4	2260 Display Station	\$ 3,956	\$ 33.00
1	2848-22 Display Control	35,600	28.50
2	2250 Display Station	\$104,400	320.00
1	2701-1 Data Adapter Unit	9,310	15.25
1	2780-2 RJE Station	43,450	265.00
		\$196,716	\$661.75/Mo. x 12 Mo./Yr.
			\$7,941/Yr.
1	2365 Processor Storage (1 Megabyte)	\$393,000	\$418.00/Mo. x 12 Mo./Yr.
			\$5,016/Yr.

No.	CID Item	Purchase	Maint. /Yr.*
1	Host Interface (PDP DQ-11)	\$ 4,200	336
1	Interface Processor & DMA (PDP)	19,500	1,560
1	CII Interface	\$137,500	11,000
		\$161,200	\$12,896/Yr.
		+ 25,000 (Int. & Test)	
		\$186,200	

*(8% of Purchase Price/Yr.)

3.1 Consumables Stock (from GSA Schedule) (6 Mo. Supply)

- a. 1 purchase of 10,000 mag. tapes
- b. 1 purchase of 20 disk packs
- c. 1 purchase of printer/typewriter paper (boxes)
- d. 1 purchase of punch cards (cartons)
- e. 1 purchase of printer/typewriter ribbons (cartons)

a.	\$8/Mag. Tape	X	10,000	=	\$80,000
b.	\$93/Disk Pack	X	20	=	1,860
c.	\$37,981/CPU - Yr.	(for 6 mo.)	=	18,945	
d.	\$4,950/CPU - Yr.	(for 6 mo.)	=	2,475	
e.	\$3,786/CPU - Yr.	(for 6 mo.)	=	<u>1,893</u>	
					\$105,173

3.2 Facility Maintenance and Operation

Cost Factors

- o Equipment Maintenance
- o Facility Operation
- o Consumables
- o Occupancy (Space)
- o Special Purpose Equipment Spares

(1) Equipment Maintenance

$$(A) = (\text{Host}) + (\text{Host Adds}) + (\text{CID}) + (\text{Simulation Comp}) \\ + (\text{CDMS})$$

$$(\text{Host}) = \text{GSA Schedule} = \$54,489 \text{ Per Yr.}$$

$$(\text{Host Adds}) = \text{GSA Schedule} = \$5,016 \text{ Per Yr.}$$

$$(\text{CID Equipment}) = 8\% \text{ Purchase} = \$12,896 \text{ Per Yr.}$$

$$(\text{Simulation Hardware}) = 8\% \text{ Purchase} = \$10,976 \text{ Per Yr.}$$

$$(\text{CDMS}) = 8\% \text{ Purchase} - \$153,600 \text{ Per Yr.}$$

$$(A) \text{ Total} = (\$54,489) + (\$5,016) + (\$12,896) + (\$10,976) \\ + (\$153,600) \\ = (\$239,977) \text{ Per Yr.}$$

Basic Host, CID and Simulation Comp. Start FY77

Host Terminal Adds and CDMS Start FY78

Host Memory Add Starts in FY79

	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>	
Host (Basic)	54.49K	54.49K	54.49K	GSA Schedule
(Terminals)		7.94	7.94	GSA Schedule
(Memory)			5.02	GSA Schedule
CID		12.90	12.90	8% Purchase Price/Yr.
Sim. Computer	<u>5.49</u>	<u>10.98</u>	<u>10.98</u>	8% Purchase Price/Yr.
Total	59.98K	86.31K	91.33K	
CDMS		<u>153.60K</u>	<u>153.60K</u>	
New Total		239.91	244.93K	

(2) Facility Operations Per Yr.

(a) (b) (c)
(Number of Shifts) X (Man Power) X (Cost/Man)

(a) Number of Shifts = No EAS Development = 1
= With EAS Development = 3

(b) Man Power = Engineering Estimate = 5
3 Required for Host
2 Required for CDMS and Simulation Equipment

(c) Cost/Man = Average Crew Cost/Man Yr. = \$40K

(a) Total = 1 X 5 X \$40K/Yr. = \$200K/Yr.

(3) Consumables (Based on Actual Use MSFC 360/65 System)

Consumables = See attached List
= \$51,272/CPU Yr.

(4) Occupancy (Space) N/A

(5) Special Purpose Equipment Spares

8% of Purchase Price/Yr.

See Attached List of Equipment

Equipment Cost \$161,200 X 8% = \$12,896/Yr.

(3) Consumables

CPU Hrs./Yr. = 2,080 (8 Hrs/Day, 5 Days/Wk.) = 1 CPU Yr.

o Electrical Power = \$79,872/CPU-Yr. (= \$38.40/CPU-Hr.)

o Line Printer and
Console Typewriter = \$37,981/CPU-Yr. (= \$18.26/CPU-Hr.)
Paper

o Tab Cards = \$4,950/CPU-Yr. (= 2.38/CPU-Hr.)

o Magnetic Tapes = \$4,555/CPU-Yr. (= 2.19/CPU-Hr.)

o Printer and
Typewriter Ribbons = \$3,786/CPU-Yr. (= 1.82/CPU-Hr.)

Less Elec. Power \$131,144/CPU-Yr. (= 63.05/CPU-Hr.)
79,872

51,272/CPU-Yr.

3.3 Host and Simulation Computer Support Software Development
and Acceptance

(1) STIL Development Software

(2) STIL Procured Software

(3) ESA Software Development Cost to Support Identified
Hardware Changes

(4) Conversion of ESA Delivered Simulation Software

(5) Acceptance Test Development

(6) Acceptance Review

(1) STIL Development Software

(a) (b)
(Number of Modules) X (Cost/Module)

(a) = Number of Modules = M&S Study - See Attached
Sheet for List

= 38 Modules

(b) = Cost/Module = \$60/Statement X 100 Statements/Module
= \$6K Per Module

(1) = (38) X (\$6K) = \$228,000

Development Cost to be Applied Equally over FY77
FY78, and FY79 \$76K Per Year

(2) STIL Procured Software

(Vendor License) See Attached Sheet for List

(2) = \$89K For FY77

(3) ESA ▲ Development Cost
NA For U. S. (\$0)

(4) Conversion of ESA Delivered Simulation Software

(a) (b) (c)
(Number of Statements) X (% Change) X (Cost/Statement)

(a) = Number of Statements = ESA Estimate
= 10,000 Statements

(b) = % Change = Engineering Estimate = 15% Due to
Hardware Configuration at ERNO vs. MSFC Proposed.

(c) = Cost/Statement = \$60 (See Ground Rules)

(4) = (10,000) X (15%) X (\$60) = \$90,000

Conversion Cost Spread Over FY78 and 79

(5) Acceptance Test Development

(a) (b) (c)
(Man Yr. Effort) X (Cost/Yr.) + (Travel)

(a) = Man Yr. Effort = Engineering Estimate Based on Size
of Software = 2 Man Yr.

(b) = Cost/Yr. = \$50K (See Ground Rules)

(c) = Travel = Number of Trips (Cost of Ticket)+
(Cost/Day X Number of Days)

= 4 (\$800 + (60 X 14))

= \$6,560

(5) Total = (2 X \$50K) + \$6,560

= \$106,560 For 1st Delivery in FY77

Delivery in FY79 (5) Total = \$88,800

FY79 Total For (5) = 10 Months Effort

$\frac{10}{12} \times \$106,560 = \$88,800$

(6) Acceptance Review

(a)	(b)
(Number of Modules)	X (Cost/Module)

(a) = ESA Estimate = 256 Modules

(b) = (Cost/Module) = Engineering Estimate
= 1 Man Week/Module = \$96.20

(6) = (256) X (96.20) = \$24,630

Three Deliveries \$24,630

Applied in FY78 and Twice in FY79

STIL SOFTWARE TO BE DEVELOPED

	Modules
1. Simulation Executive Control	10
2. Interactive (CDMS) Debug	15
3. Modifications to Vendor Supplied	5
4. Special Purpose Interface	4
5. Goal Interpreter (Simulation Computer)	<u>4</u>
	38

STIL PROCURED SOFTWARE

1. Real-Time Operating System (Simulation Computer)	4,000
2. Data Base Management System (Host)	<u>10,000</u>
3. Cross Compiler, Assembler, Link Editor	\$75,000

ESA SOFTWARE TO BE CONVERTED

1. CDMS Sim. 20,000 Inst. = 4,000 Statements
2. EGSE Sim. 20,000 Inst. = 4,000
3. S/L Sim. 10,000 Inst. = 2,000

3.4 Host and Simulation Computer Support Software Maintenance and Distribution

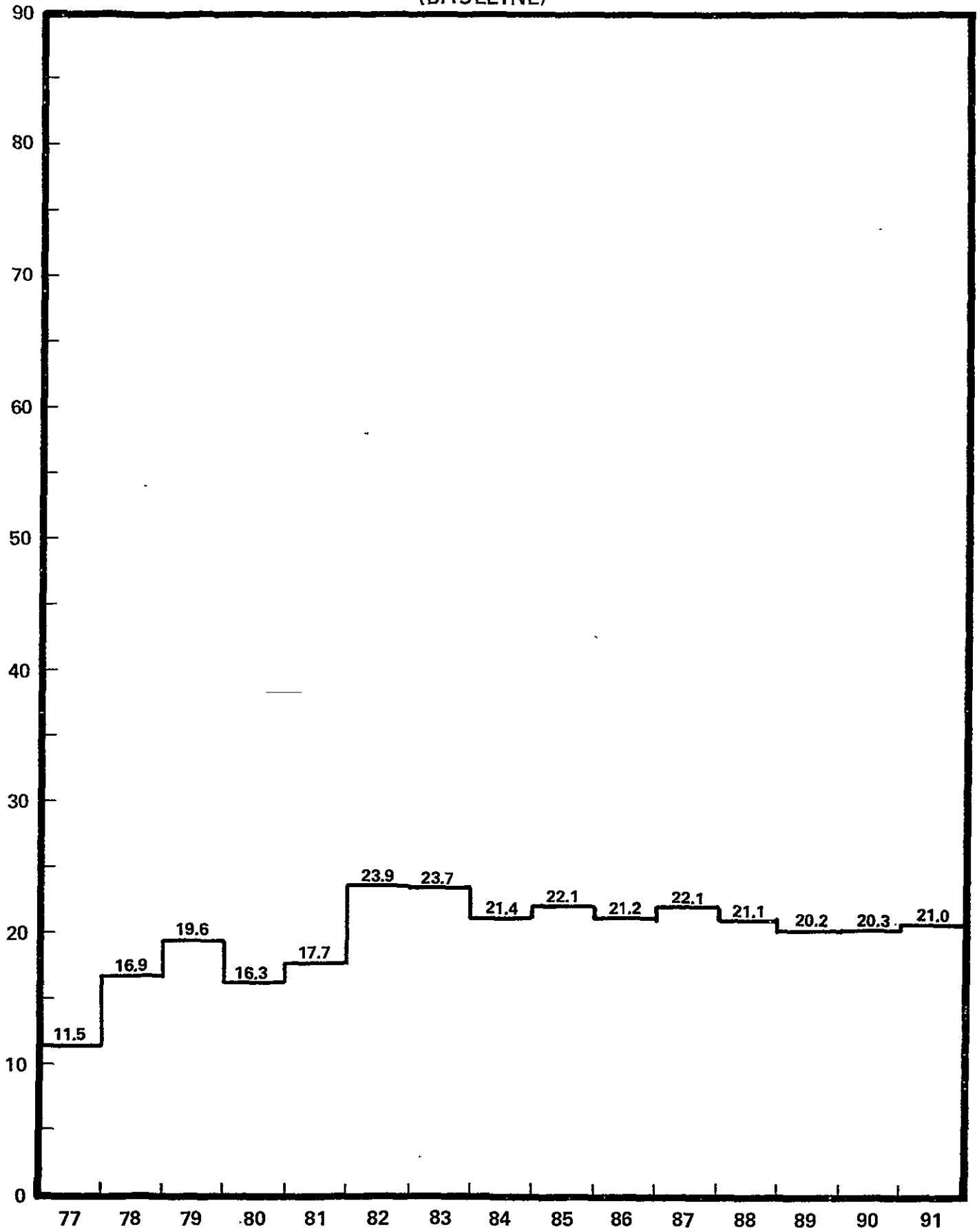
(1) Maintenance and Documentation

(Level of Effort)

(A) = Engineering Estimate = 2.5 Man Yr. / Yr.

(1) = (2.5) X (\$50K) = \$125,000 Per Yr.

OPTION I A1
SPACELAB MANPOWER
(BASELINE)



COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
1.1		0	0	90.00	0	0	0	0
1.2		56.56	56.56	117.81	54.23	0	0	0
1.3		0	0	0	27.72	83.16	166.32	27.20
1.4		0	0	11.52	15.37	23.06	34.61	44.23
1.5		116.56	82.81	82.81	26.25	0	0	0
1.6		0	0	0	24.84	54.65	99.36	121.72
1.7		0	0	9.87	10.83	12.76	15.64	18.05
2.1		0	0	0	0	0	0	0
2.2		116.56	126.46	126.46	69.90	0	0	0
2.3		0	0	0	87.30	192.06	349.20	427.77
2.4		0	0	0	72.24	79.93	91.48	101.10
2.5		56.56	71.94	0	0	0	0	0
2.6		0	0	32.00	32.00	32.00	32.00	32.00
2.7		0	0	8.00	8.00	8.00	8.00	8.00
3.1		408.92	2236.37	0	0	0	0	0
3.2		59.98	439.91	511.10	511.10	511.10	511.10	511.10
3.3		271.56	170.63	234.06	0	0	0	0
3.4		0	62.50	125.00	125.00	125.00	125.00	125.00
TOTAL		1086.70	3247.18	1348.69	1064.78	1121.72	1432.71	1416.17
ESCALATED TOTAL		1244.16	3977.94	1767.86	1493.41	1683.40	2300.62	2433.24

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
1.1	0	0	0	0	0	0	0	0
1.2	0	0	0	0	0	0	0	0
1.3	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20
1.4	48.08	51.92	51.92	57.70	57.70	57.70	63.47	67.32
1.5	0	0	0	0	0	0	0	0
1.6	96.88	101.84	91.91	99.36	89.42	79.49	77.00	81.97
1.7	19.01	19.97	19.97	21.41	21.41	21.41	22.85	23.82
2.1	0	0	0	0	0	0	0	0
2.2	0	0	0	0	0	0	0	0
2.3	340.47	357.93	323.01	349.20	314.28	279.36	270.63	288.09
2.4	104.95	108.79	108.79	114.57	114.57	114.57	120.34	124.19
2.5	0	0	0	0	0	0	0	0
2.6	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00
2.7	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
3.1	0	0	0	0	0	0	0	0
3.2	511.10	511.10	511.10	511.10	511.10	511.10	511.10	511.10
3.3	0	0	0	0	0	0	0	0
3.4	125.00	125.00	125.00	125.00	125.00	125.00	125.00	125.00
TOTAL	1312.69	1343.75	1298.90	1345.54	1300.68	1255.83	1257.59	1288.69
ESCALATED TOTAL	2413.33	2643.36	2733.99	3030.41	3134.44	3238.20	3469.73	3804.42
TOTAL COST	21,121.56							
ESCALATED TOTAL COST	39,368.51							

AVERAGE COST PER FLIGHT 174.20

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
1.1		0	0	0	0	0	0	0
1.2		1.0	1.0	1.8	0.7	0	0	0
1.3		0	0	0	0.6	1.7	3.3	0.5
1.4		0	0	0.2	0.3	0.4	0.7	0.9
1.5		2.2	1.5	1.5	0.5	0	0	0
1.6		0	0	0	0.5	1.1	1.9	2.4
1.7		0	0	0.2	0.3	0.3	0.3	0.4
2.1		0	0	0	0	0	0	0
2.2		2.2	2.4	2.4	1.4	0	0	0
2.3		0	0	0	1.7	3.8	7.0	8.6
2.4		0	0	0	1.5	1.6	1.9	2.1
2.5		1.0	1.3	0	0	0	0	0
2.6		0	0	0.6	0.6	0.6	0.6	0.6
2.7		0	0	0.2	0.2	0.2	0.2	0.2
3.1		1.5	0.5	0	0	0	0	0
3.2		0	5.5	5.5	5.5	5.5	5.5	5.5
3.3		3.6	3.4	4.7	0	0	0	0
3.4		0	1.3	2.5	2.5	2.5	2.5	2.5
TOTAL MANPOWER		11.5	16.9	19.6	16.3	17.7	23.9	23.7

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
1.1	0	0	0	0	0	0	0	0
1.2	0	0	0	0	0	0	0	0
1.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1.4	0.9	1.0	1.0	1.1	1.1	1.1	1.2	1.3
1.5	0	0	0	0	0	0	0	0
1.6	1.9	2.0	1.8	2.0	1.7	1.6	1.5	1.6
1.7	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5
2.1	0	0	0	0	0	0	0	0
2.2	0	0	0	0	0	0	0	0
2.3	6.8	7.2	6.5	7.0	6.3	5.5	5.4	5.8
2.4	2.1	2.2	2.2	2.3	2.3	2.3	2.4	2.5
2.5	0	0	0	0	0	0	0	0
2.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
2.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
3.1	0	0	0	0	0	0	0	0
3.2	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
3.3	0	0	0	0	0	0	0	0
3.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
TOTAL MANPOWER	21.4	22.1	21.2	22.1	21.1	20.2	20.3	21.0

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
1.1 CDMS HARDWARE MODIFICATIONS								
1) MAIN MEMORY ADDITION				90.00				
2) MASS STORAGE MODIFICATION				N/A*				
LABOR COST								
MANPOWER								
TOTAL COST				90.00				

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
1.2 SUBSYSTEM COMPUTER SOFTWARE DEVELOPMENT AND ACCEPTANCE								
(1) Acceptance Test Development		56.56 (1.0)	56.56 (1.0)	56.56 (1.0)	23.60 (0.4)			
(2) Acceptance Review				14.11 (0.3)	7.06 (0.1)			
(3) Installation at NASA				47.14 (0.5)	23.57 (0.2)			
LABOR COST								
MANPOWER		(1.0)	(1.0)	(1.8)	(0.7)			
TOTAL COST		56.56	56.56	117.81	54.23			

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
1.2 SUBSYSTEM COMPUTER SOFTWARE DEVELOPMENT & ACCEPTANCE								
(1) Acceptance Test Development								
(2) Acceptance Review								
(3) Installation at NASA								
LABOR COST								
MANPOWER								
TOTAL COST								

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
1.3 SUBSYSTEMS COMPUTER SOFTWARE MAINTENANCE (1) Maintenance					27.72 (0.6)	83.16 (1.7)	166.32 (3.3)	27.20 (0.5)
LABOR COST								
MANPOWER					(0.6)	(1.7)	(3.3)	(0.5)
TOTAL COST					27.72	83.16	166.32	27.20

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
1.3 SUBSYSTEMS COMPUTER SOFTWARE MAINTENANCE								
(1) Maintenance	27.20 (0.5)	27.20 (0.5)	27.20 (0.5)	27.20 (0.5)	27.20 (0.5)	27.20 (0.5)	27.20 (0.5)	27.20 (0.5)
LABOR COST								
MANPOWER	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
TOTAL COST	27.20	27.20	27.20	27.20	27.20	27.20	27.20	27.20

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
1.4 SUBSYSTEMS COMPUTER SOFTWARE CONFIGURATION MANAGEMENT, RELEASE & DISTRIBUTION								
(1) Configuration Management				11.52 (.2)	11.52 (.2)	11.52 (.2)	11.52 (.2)	11.52 (.2)
(2) & (3) Set Build & Set Verification					3.85 (.1)	11.54 (.2)	23.09 (.5)	32.71 (.7)
LABOR COST								
MANPOWER				(.2)	(.3)	(.4)	(.7)	(.9)
TOTAL COST				11.52	15.37	23.06	34.61	44.23

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
1.4 SUBSYSTEMS COMPUTER SOFTWARE CONFIGURATION MANAGEMENT, RELEASE & DISTRIBUTION								
(1) Configuration Management	11.52 (.2)	11.52 (.2)	11.52 (.2)	11.52 (.2)	11.52 (.2)	11.52 (.2)	11.52 (.2)	11.52 (.2)
(2) & (3) Set Build & Set Verification	36.56 (.7)	40.40 (.8)	40.40 (.8)	46.18 (.9)	46.18 (.9)	46.18 (.9)	51.95 (1.0)	55.80 (1.1)
LABOR COST								
MANPOWER	(.9)	(1.0)	(1.0)	(1.1)	(1.1)	(1.1)	(1.2)	(1.3)
TOTAL COST	48.08	51.92	51.92	57.70	57.70	57.70	63.47	67.32

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
1.5 EXPERIMENT COMPUTER SOFTWARE DEVELOPMENT & ACCEPTANCE								
(1) Acceptance Test Development		56.56 (1.0)	56.56 (1.0)	56.56 (1.0)	0			
(2) Acceptance Review		0	6.05 (.1)	6.05 (.1)	6.05 (.1)			
(3) Installation at NASA		0	20.20 (.4)	20.20 (.4)	20.20 (.4)			
(4) Graphics Software Package		60.00 (1.2)	0	0	0			
LABOR COST								
MANPOWER		(2.2)	(1.5)	(1.5)	(.5)			
TOTAL COST		116.56	82.81	82.81	26.25			

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
1.5 EXPERIMENT COMPUTER SOFTWARE DEVELOPMENT & ACCEPTANCE								
(1) Acceptance Test Development								
(2) Acceptance Review								
(3) Installation at NASA								
(4) Graphics Software Package								
LABOR COST								
MANPOWER								
TOTAL COST								

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
1.6 EXPERIMENT COMPUTER SOFTWARE MAINTENANCE								
(1) New Flight Maintenance					24.84 (0.5)	49.68 (0.1)	86.94 (1.7)	99.36 (2.0)
(2) Reflight Maintenance					0 (0)	4.97 (0.1)	12.42 (0.2)	23.36 (0.4)
LABOR COST								
MANPOWER					(0.5)	(1.1)	(1.9)	(2.4)
TOTAL COST					24.84	54.65	99.36	121.72

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
1.6 EXPERIMENT COMPUTER SOFTWARE MAINTENANCE								
(1) New Flight Maintenance	62.10 (1.2)	62.10 (1.2)	49.68 (1.0)	49.68 (1.0)	37.26 (0.7)	24.84 (0.5)	12.42 (0.2)	12.42 (0.2)
(2) Reflight Maintenance	34.78 (0.7)	39.74 (0.8)	42.23 (0.8)	49.68 (1.0)	52.16 (1.0)	54.65 (1.1)	64.58 (1.3)	59.55 (1.4)
LABOR COST								
MANPOWER	(1.9)	(2.0)	(1.8)	(2.0)	(1.7)	(1.6)	(1.5)	(1.6)
TOTAL COST	96.88	101.84	91.91	99.36	89.42	79.49	77.00	81.97

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
1.7 EXPERIMENT COMPUTER SOFTWARE								
(1) Configuration Management				9.87 (.2)	9.87 (.2)	9.87 (.2)	9.87 (.2)	9.87 (.2)
(2) & (3) Set Build & Set Verification					.96 (.1)	2.89 (.1)	5.77 (.1)	8.18 (.2)
LABOR COST								
MANPOWER				(.2)	(3.)	(.3)	(.3)	(.4)
TOTAL COST				9.87	10.83	12.76	15.64	18.05

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
1.7 EXPERIMENT COMPUTER SOFTWARE								
(1) Configuration Management	9.87 (.2)	9.87 (.2)	9.87 (.2)	9.87 (.2)	9.87 (.2)	9.87 (.2)	9.87 (.2)	9.87 (.2)
(2) & (3) Set Build & Set Verification	9.14 (.2)	10.10 (.2)	10.10 (.2)	11.54 (.2)	11.54 (.2)	11.54 (.2)	12.98 (.3)	13.95 (.3)
LABOR COST								
MANPOWER	(.4)	(.4)	(.4)	(.4)	(.4)	(.4)	(.5)	(.5)
TOTAL COST	19.01	19.97	19.97	21.41	21.4	21.41	22.85	23.82

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
2.1 EGSE HARD- WARE MODIFICATIONS								
LABOR COST								
MANPOWER								
TOTAL COST								

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
2.1 EGSE HARD- WARE MODIFICATIONS								
LABOR COST								
MANPOWER								
TOTAL COST								

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
2.2 GROUND CHECK- OUT SOFTWARE DEVELOPMENT & ACCEPTANCE								
(1) Acceptance Test Development		56.56 (1.0)	56.56 (1.0)	56.56 (1.0)	0			
(2) Acceptance Review		0	41.91 (.8)	41.91 (.8)	41.91 (.8)			
(3) Installation at NASA			27.99 (.6)	27.99 (.6)	27.99 (.6)			
(4) Graphics Software Package		60.00 (1.2)	0	0	0			
LABOR COST								
MANPOWER		(2.2)	(2.4)	(2.4)	(1.4)			
TOTAL COST		116.56	126.46	126.46	69.90			

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ELEMENT COST

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COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
2.2 Same as 1 of 2								
LABOR COST								
MANPOWER								
TOTAL COST								

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
2.3 GROUND CHECK- OUT SOFTWARE MAINTENANCE								
(1) New Flight Maintenance					87.30 (1.7)	174.50 (3.5)	305.55 (6.1)	349.20 (7.0)
(2) Reflight Maintenance					0 (0)	17.46 (0.3)	43.65 (0.9)	78.57 (1.6)
LABOR COST								
MANPOWER					(1.7)	(3.8)	(7.0)	(8.6)
TOTAL COST					87.30	192.06	349.20	427.77

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
2.3 GROUND CHECK- OUT SOFTWARE MAINTENANCE								
(1) New Flight Maintenance	218.25 (4.4)	218.25 (4.4)	174.60 (3.5)	174.60 (3.5)	130.95 (2.6)	87.30 (1.7)	43.65 (0.9)	43.65 (0.9)
(2) Reflight Maintenance	122.22 (2.4)	139.68 (2.8)	148.41 (3.0)	174.60 (3.5)	183.33 (3.7)	192.06 (3.8)	226.98 (4.5)	244.44 (4.9)
LABOR COST								
MANPOWER	(6.8)	(7.2)	(6.5)	(7.0)	(6.3)	(5.5)	(5.4)	(5.8)
TOTAL COST	340.47	357.93	323.01	349.20	314.28	279.36	270.63	288.09

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
2.4 GROUND CHECK- OUT SOFTWARE CONFIGURATION MANAGEMENT, RELEASE & DISTRIBUTION								
(1) Configuration Management					68.39 (1.4)	68.39 (1.4)	68.39 (1.4)	68.39 (1.4)
(2) & (3) Set Build & Set Verification					3.85 (.1)	11.54 (.2)	23.09 (.5)	32.71 (.7)
LABOR COST								
MANPOWER					(1.5)	(1.6)	(1.9)	(2.1)
TOTAL COST					72.24	79.93	91.48	101.10

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
2.4 GROUND CHECK- OUT SOFTWARE CONFIGURATION MANAGEMENT, RELEASE & DISTRIBUTION								
(1) Configuration Management	68.39 (1.4)	68.39 (1.4)	68.39 (1.4)	68.39 (1.4)	68.39 (1.4)	68.39 (1.4)	68.39 (1.4)	68.39 (1.4)
(2) & (3) Set Build & Set Verifi- cation	36.56 (.7)	40.40 (.8)	40.40 (.8)	46.18 (.9)	46.18 (.9)	46.18 (.9)	51.95 (1.0)	55.80 (1.1)
LABOR COST								
MANPOWER	(2.1)	(2.2)	(2.2)	(2.3)	(2.3)	(2.3)	(2.4)	(2.5)
TOTAL COST	104.95	108.79	108.79	114.57	114.57	114.57	120.34	124.19

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
2.5 EGSE COMPUTER SOFTWARE PRODUCTION SET DEVELOP- MENT & ACCEPTANCE								
(1) Acceptance Test Development		56.56 (1.0)	56.56 (1.0)					
(2) Acceptance Review		0	9.22 (.2)					
(3) Installation at NASA		0	6.16 (.1)					
LABOR COST								
MANPOWER		(1.0)	(1.3)					
TOTAL COST		56.56	71.94					

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
2.5 Same as 1 of 2								
LABOR COST								
MANPOWER								
TOTAL COST								

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
2.6 EGSE COMPUTER SOFTWARE PRODUCTION DEVELOPMENT & ACCEPTANCE								
(1) Maintenance				32.00 (.6)	32.00 (.6)	32.00 (.6)	32.00 (.6)	32.00 (.6)
LABOR COST								
MANPOWER				(.6)	(.6)	(.6)	(.6)	(.6)
TOTAL COST				32.00	32.00	32.00	32.00	32.00

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
2.6 EGSE COMPUTER SOFTWARE PRODUCTION SET DEVELOPMENT & ACCEPTANCE								
(1) Maintenance	32.00 (.6)	32.00 (.6)	32.00 (.6)	32.00 (.6)	32.00 (.6)	32.00 (.6)	32.00 (.6)	32.00 (.6)
LABOR COST								
MANPOWER	(.6)	(.6)	(.6)	(.6)	(.6)	(.6)	(.6)	(.6)
TOTAL COST	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
2.7 GSE COMPUTER SOFTWARE PRODUCTION SET CONFIGURATION MANAGEMENT, RELEASE & DISTRIBUTION (1), (2) & (3) Configuration Management, Set Build & Set Verification				8.00 (.2)	8.00 (.2)	8.00 (.2)	8.00 (.2)	8.00 (.2)
LABOR COST								
MANPOWER				(.2)	(.2)	(.2)	(.2)	(.2)
TOTAL COST				8.00	8.00	8.00	8.00	8.00

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
2.7 EGSE COMPUTER SOFTWARE PRODUCTION SET CONFIGURATION MANAGEMENT, RELEASE & DISTRIBUTION								
(1), (2) & (3) Configuration Management, Set Build & Set Verification	8.00 (.2)	8.00 (.2)	8.00 (.2)	8.00 (.2)	8.00 (.2)	8.00 (.2)	8.00 (.2)	8.00 (.2)
LABOR COST								
MANPOWER	(.2)	(.2)	(.2)	(.2)	(.2)	(.2)	(.2)	(.2)
TOTAL COST	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
3.1 STIL FACILITY ACQUISITION								
(1) Host Computer Equipment		196.72	0	0				
(2) Computer Inter-face Device		0	186.20	0				
(3) Simulation Computer		137.20	0	0				
(4) CDMS Equipment			1920.00	0				
(5) EGSE Equipment		0	0	0				
(6) Facility Integration Testing		25.00 (.5)	25.00 (.5)	0				
(7) Consumable Stock		0	105.17	0				
(8) Facility Modifications	(99.00)	0	0	0				
(9) Engineering Design		50.00 (1.0)						
LABOR COST								
MANPOWER		(1.5)	(.5)					
TOTAL COST		408.92	2,236.37	0.0				

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ELEMENT COST

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COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
3.1 Same as 1 of 2								
LABOR COST								
MANPOWER								
TOTAL COST								

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
3.2 STIL FACILITY OPERATION & MAINTENANCE								
(1) Equipment Maintenance		59.98	239.91 (1.5)	244.93 (1.5)	244.93 (1.5)	244.93 (1.5)	244.93 (1.5)	244.93 (1.5)
(2) Facility Operation			200.00 (4.0)	200.00 (4.0)	200.00 (4.0)	200.00 (4.0)	200.00 (4.0)	200.00 (4.0)
(3) Consumables				51.27	51.27	51.27	51.27	51.27
(4) Occupancy.Space								
(5) Special Purpose Equipment Spares			14.90	14.90	14.90	14.90	14.90	14.90
LABOR COST								
MANPOWER		(5.5)	(5.5)	(5.5)	(5.5)	(5.5)	(5.5)	(5.5)
TOTAL COST		59.98	439.91	511.10	511.10	511.10	511.10	511.10

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
3.2 STIL FACILITY OPERATION & MAINTENANCE								
(1) Equipment Maintenance	244.93 (1.5)	244.93 (1.5)	244.93 (1.5)	244.93 (1.5)	244.93 (1.5)	244.93 (1.5)	244.93 (1.5)	244.93 (1.5)
(2) Facility Operation	200.00 (4.0)	200.00 (4.0)	200.00 (4.0)	200.00 (4.0)	200.00 (4.0)	200.00 (4.0)	200.00 (4.0)	200.00 (4.0)
(3) Consumables	51.27	51.27	51.27	51.27	51.27	51.27	51.27	51.27
(4) Occupancy (Space)								
(5) Special Purpose Equipment Spares	14.90	14.90	14.90	14.90	14.90	14.90	14.90	14.90
LABOR COST								
MANPOWER	(5.5)	(5.5)	(5.5)	(5.5)	(5.5)	(5.5)	(5.5)	(5.5)
TOTAL COST	511.10	511.10	511.10	511.10	511.10	511.10	511.10	511.10

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
3.3 HOST & SIMU- LATION COM- PUTER SUPPORT SOFTWARE DEVELOPMENT & ACCEPTANCE								
(1) STIL Development		76.00 (1.5)	76.00 (1.5)	76.00 (1.5)				
(2) STIL Procured		89.00	0	0				
(3) ESA Develop- ment cost for Identified Hard- ware Modifications		0	0	0				
(4) Conversion of ESA Delivered Software		0	70.00 (1.4)	20.00 (.4)				
(5) Acceptance Test		106.56 (2.1)	0	88.80 (1.8)				
(6) Acceptance Review		0	24.63 (.5)	49.26 (1.0)				
LABOR COST								
MANPOWER		(3.6)	(3.4)	(4.7)				
TOTAL COST		271.56	170.63	234.06				

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ELEMENT COST

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COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
3.3 Same as 1 of 2								
LABOR COST								
MANPOWER								
TOTAL COST								

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
3.4 HOST & SIMU- LATION COM- PUTER SUPPORT SOFTWARE MAINTENANCE & DISTRUBUTION								
(1) & (2) Maintenance & Distrubution		62.50 (1.3)	125.00 (2.5)	125.00 (2.5)	125.00 (2.5)	125.00 (2.5)	125.00 (2.5)	125.00 (2.5)
LABOR COST								
MANPOWER		(1.3)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)
TOTAL COST		62.50	125.00	125.00	125.00	125.00	125.00	125.00

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
3.4 HOST & SIMU- LATION COM- PUTER SUPPORT SOFTWARE MAINTENANCE & DISTRIBUTION								
(1) & (2) Maintenance & Distribution.	125.00 (2.5)	125.00 (2.5)	125.00 (2.5)	125.00 (2.5)	125.00 (2.5)	125.00 (2.5)	125.00 (2.5)	125.00 (2.5)
LABOR COST								
MANPOWER	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)
TOTAL COST	125.00	125.00	125.00	125.00	125.00	125.00	125.00	125.00

APPROVAL


SPACELAB EXPERIMENT COMPUTER STUDY

Volume III: Space Cost Data

By James L. Lewis, Bobby C. Hodges, and J. O. Christy

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J. T. POWELL
Director, Data Systems Laboratory

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